M.Tech (Microelectronics & VLSI)
First Year, Semester-II

A. THEORY							
Sl. No.	Subject Code	Theory	Contact Hours/Week				Credit
			L	T	P	Total	
1	MVLSI201	Digital Signal Processing & Applications	3	1	0	4	4
2	MVLSI202	Analog IC Design	3	1	0	4	4
3	MVLSI203	Program Elective-1 A. Quantum & Nano Science B. Quantum Computing & Information	3	1	0	4	4
4	MVLSI204	Program Elective-2 A. Introduction to MEMS B. Advanced Micro & Nano Devices	3	1	0	4	4
5	MVLSI205	Program Elective-3 A. Mobile Communication B. Soft Nano Technology	3	1	0	4	4
TOTAL OF THEORY							20
B. PRACTICAL							
6	MVLSI283	Embedded System Lab-II	0	0	3	3	2
7	MVLSI281	Comprehensive Viva-Voce	0	0	0	0	1
8	MVLSI282	Seminar – Term Paper Leading To Project	0	0	3	3	1
TOTAL OF PRACTICAL							4
TOTAL OF SEMESTER							24

University of Engineering & Management Jaipur

Second Semester Syllabus

TITLE OF COURSE: DIGITAL SIGNAL PROCESSING AND APPLICATIONS
COURSE CODE: MVLSI201
L-T-P SCHEME: 3-1-0
COURSE CREDITS: 4

Course Outcomes (CO):
Upon successful completion of this course, students should be able to:
CO1: Interpret, represent and process discrete/digital signals and sytems.
CO2: Practical implementation issues such as computational complexity, hardware resource limitations as well as cost of DSP systems or DSP Processors.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓							✓
CO2	✓	✓	✓	✓								✓

Course Contents:
Unit 1: Concept of discrete-time signal, basic idea of ampling and reconstruction of signal, sampling theorem, sequences–periodic, energy,power,unit-sample, unit-step, unit-ramp, real & complex exponentials, arithmetic operations on sequences.
Unit 2: LTI Systems: Definition, representation, impulse response, derivation for the outputs equence, concept of convolution, graphical, analytical and overlap-add methods to compute convolution supported with examples and exercises, properties of convolution, interconnections of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems.
Unit 3: Discrete Fourier Transform: Concept and relations for DFT/IDFT, Twiddle factors and their properties, computational burden on direct DFT, D FT/IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error,filtering of long data sequences–Overlap-Saveand Overlap-Add methods with examples and exercises.
Unit 4: Fast Fourier Transform: Radix-2 algorithm, decimation-in-Time, decimation-in-frequency algorithms, bit reversal.
Unit 5:Z-Transform: Definition, mapping betweens- planeandz- plane, unitcircle, convergence and ROC, properties of Z-transform, Z- transformons equences with examples and exercises, characteristic families of signals along with ROC, convolution, correlation and multiplication using Z-transform, initial value theorem, Perseval's relation, inverse Z-transform by partial-fraction expansions with examples and exercises.

Unit 6: Filter Design: Basic concepts of IIR and FIR filters, difference equations, design of Butter worth IIR analog filter using impulse in variant and bilinear transforms, design of linear phase FIR filters, no. of taps, rectangular, Hamming and Blackman windows**.**
Unit 7: Digital Signal Processor: Elementary idea about the architecture and important instruction sets of TMS 320C5416/6713 processor, and basic concept of FPGA.

Text Books
1. DigitalSignal Processing – "Digital Signal Processing: A Modern introduction", Ashok mbardar, Cenage Learning India private limited
2. DigitalSignal Processing – "Principles, Algorithms and Applications", J.G.Proakis & D.G. Manolakis, Pearson Ed.

3.Texas Instruments DSP Processor user manuals and application notes.
4. Xilinx FPGA user manuals and application notes.

References

1. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co.
2. Digital Signal Processing - Signals, Systems and Filters, A. Antoniou,TMH Publishing Co.
3. Digital Signal Processing, A. Nagoor Kani, TMH Education
4. Digital Signal Processing with Field Programmable Gate Arrays, U. Meyer - Baese, Springer.

Title of Course: Analog IC Design
Course Code: MVLSI202
L-T-P Scheme: 3-1-0 **Course Credits: 4**

Course Contents:

Module – I: Introduction
Basic analog building blocks, Switches, Active resistors, Current and Voltage sources, Current mirrors, Current and voltage references, Voltage regulators, Negative feedback amplifier
Module – II: CMOS Operation Amplifiers:
Basic Concepts – Performance Parameters, Single stage OPAMP, Two-stage OPAMP, Stability and Phase compensation, Basic current mirrors- CASCODE current mirrors- Active current mirrors, large and small signal analysis
Module – III: Frequency response of amplifiers
General considerations- Miller Effect and association of poles with nodes, Common source stage- Source followers,
Module – IV: Noise in MOS circuits
Noise-Statistical characteristics of noise- Types of noise- Representation of noise in circuits- Noise in single stage amplifiers- Noise in differential pairs- Noise Bandwidth.

Text Books

1. CMOS Analog Circuit Design (second edition) Phillip E. Allen and Douglas R. Holberg (Oxford)

References

1. Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw Hill, 2001, 33 rd re-print, 2016.
2. “Analog MOS Integrated Circuits for Signal Processing”, Roubic Gregorian and Gabor C. Temes, John Wiley & Sons, 1986.

Syllabus references:
[1] “Analog IC Design,” National Institute of Technology Raipur, Department of Electronics and Telecommunication, p. 14, accessed online: https://nitrr.ac.in/downloads/syllabus/SYLLABUS%20FOR%20M.TECH%20VLSI%20DESIGN%20&%20EMBEDDED%20SYSTEM.pdf
[2] “Analog IC Design,” NPTEL, accessed online: https://archive.nptel.ac.in/courses/108/106/108106105/

TITLE OF COURSE: QUANTUM AND NANO SCIENCE
COURSE CODE: MVLSI203A
L-T-P: 3-1-0
CREDITS: 4
Course Outcomes (CO):
Upon successful completion of this course, students should be able to:
CO1: Learn about the background on Nanoscience
CO2: Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment.

CO3: size and shape controlled synthesis of nanomaterials and their future applications in industry.
CO4: To introduce the quantum mechanical aspects of nanotechnology.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2		✓	✓	✓								
CO3		✓	✓									
CO4	✓	✓	✓									

Course Contents:

Quantum & Statistical Mechanics
Wave particle duality and Schrodinger equation, Free and bound particles, Eigen functions, Quantum mechanical operators, Probability current density, Particle in square well potential, Maxwell-Boltzmann statistics, Bose-Einstein and Fermi-Dirac statistics, Concept of phonons.

Quasi Low-Dimensional Structures
Quantum wells, Wires, Dots, Band structure of low-dimensional systems, Quantum confinement, Density-ofstates in 2D, 1D and 0D structures, Heterostructures and bandgap engineering, Modulation doping, Strained layer structures.

Electrical and Optical Properties of Low-Dimensional Systems
Infinitely deep square wells, Wells of finite depth, Parabolic wells, Superlattices; Scattering mechanisms, Mobility enhancement, tunneling in heterostructures, Quantum Hall effect, Optical absorption in quantum wells: Intersubband transitions, Quantum well laser, Resonant tunneling.

Physics of Nanostructure Devices
Single electron transistors: Coulomb block phenomenon, Fabrication and applications, Memory devices, Quantum computer, Spintronic, Molecular electronic devices.

Carbon Nanotubes
Types of nanotubes and their formation, Properties of nanotubes, Uses in nanoelectronics, Carbon Nanotube transistors, Future prospect.

Text Books:

1. " Quantum Heterostructure – Microelectronics and Optoelectronics" by V.V. Mitin, V.A. Kochelap andM.A . Stroscio (Cambridge Univ Press, 1999).
2. "The Physics of Low Dimensional Semiconductors – An Introduction" by John H. Davies CambridgeUniversity Press, 1998
3. "Physics of Semiconductors and Their Heterostructures" by Jasprit Singh.
4. "Quantum Wells, Wires, and Dots" by P.HarrisonChichester: (Wiley 2000)
5. "Nanotechnology" by M. Wilson, K. Kannangara, G..Smith, M..Simmons, and B. Ragus (Overseas Press,2005)

TITLE OF COURSE: QUANTUM COMPUTING & INFORMATION
COURSE CODE: MVLSI203B
L-T-P: 3-1-0
CREDITS: 4

Module 1
Foundations of Quantum Physics:
Postulates, Two state quantum system, Stern Gerlach Experiment, Pauli Matrices.

Module 2
Classical Computation :
Classical computation and Classical information, Shannon entropy, classical computers and gates, computational complexity

Module 3
Quantum Computation:
Qubit Representation, Single Qubit Gates, Multiple Qubit Gates, Quantum Circuits, Bell States, Quantum Teleportation.

Module 4
Quantum Algorithms:
Quantum algorithms, Quantum information theory, Quantum Cryptography.

Module 5
Physical Systems :
Physical realizations of quantum computers, quantum error correction, cavity based quantum computing.

Text Book:
1. Quantum Computation and Quantum Information by by Michael A. Nielsen, Isaac L. Chuang

References:
2. Introduction to Classical and Quantum Computing by by Dr Thomas G Wong
3. Quantum Computer Science: An Introduction by N. David Mermin

Title of Course: Introduction to MEMS

Course Code: MVLSI204A

L-T-P: 3-1-0

Credits: 4

Course Outcomes (CO):

At the end of this course, students will demonstrate the ability to

CO1: To develop understanding of the basic Knowledge of MEMS devices.

CO2: To develop understanding various electrical and mechanical properties of MEMS materials.

CO3: To develop understanding of various design and fabrication technique of MEMS devices.

CO4: To understand the concept of various MEMS sensors and actuators.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓							✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓					✓				✓
CO4	✓	✓	✓								✓	✓

Course Contents:

Unit –I: Overview and introduction to MEMS

History of MEMS Development, Characteristics of MEMS-miniaturization, Introduction to Design of MEMS, Overview of Micro-electro-mechanical Systems, Applications of Micro-electro-mechanical systems, and Materials for MEMS: Silicon, silicon compounds, polymers, metals.

Unit –II: Electrical and mechanical properties of MEMS materials

Conductivity of semiconductors, crystal plane and orientation, fundamentals of stress and strain, mechanical properties of silicon and thin films, Types of beam, deflection of beam, longitudinal stain under pure bending, spring constant, resonance and quality factor, Fundamentals of electrostatics and energy dissipation.

Unit –III: MEMS fabrication technologies

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation, Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating, Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials

Unit –IV: Micro Sensors

Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors, engineering mechanics behind these Micro sensors.

Unit –V: Micro Actuators

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps.

Text Book:

1. Marc Madou, “Fundamentals of Micro fabrication”, CRC press 1997.

2. Stephen D. Senturia,” Micro system Design”, Kluwer Academic Publishers, 2001.

Reference Books:

1. Tai Ran Hsu,”MEMS and Microsystems Design and Manufacture”, Tata McGraw Hill, 2002.

2. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006.

3. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures” CRC Press, 2002.

TITLE OF COURSE: MOBILE COMMUNICATION
COURSE CODE: MVLSI205A
L-T-P: 3-1-0
CREDITS: 4
Course Outcomes (CO):
Upon successful completion of this course, students should be able to:
CO1: To make students familiar with various generations of mobile communications
CO2: Knowledge of GSM mobile communication standard, its architecture, logical channels, advantages and limitations.
CO3: Knowledge of 3G mobile standards and their comparison with 2G technologies.
CO4: To understand the concept of cellular communication
Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2		✓	✓	✓								
CO3		✓	✓									
CO4	✓	✓	✓									

Course Contents:
Introduction - evolution of mobile radio communications, mobile radio systems around the world, trends in cellular radio and personal communication, first generation (1G), second generation (2G), third generation (3G) mobile cellular networks.
Cellular concept – Limitations of conventional mobile system, Introduction to mobile cellular communication, concept of frequency reuse, cluster size, cellular system architecture, channel assignment strategies, call handoff strategies - hard handoff and soft handoff, prioritizing handoff; interference and system capacity, improving capacity in cellular systems – cell splitting, sectoring, microcell zone concept. **Different mobile communication systems –** GSM services and features, system architecture, GSM radio subsystem, GSM channel types, location updating and call setup, WAP, SCSD, GPRS, EDGE, 3G W- CDMA; CDMA digital cellular standard, comparison between GSM and CDMA, 3G cdma2000, IMT-2000.
Radio Channel Characterization – Free space propagation, Multipath propagation, diversity techniques, Co-channel interference, Propagation effects - scattering, ground reflection, fading, Log-normal shadowing. **Wireless networks –** Advantages and applications of Wireless LAN, WLAN technology – RF and IR wireless LAN, diffuse, quasi-diffuse and point-topoint IR wireless LAN, IEEE802.11, IEEE802.11 architecture, Physical layer, MAC layer, Introduction to WI-FI, HIPERLAN2, Bluetooth – Bluetooth architecture.
Mobile network and transport layer – Introduction to Mobile IP, requirements, IP packet delivery, Agent discovery, Registration, Tunneling and encapsulation, Optimization, Reverse tunneling; Mobile adhoc networks – Routing, Destination sequence distance vector, Dynamic source routing and Alternative metrics; Traditional TCP – Congestion control, Slow start, Fast retransmit / fast recovery, Implications of mobility; classical TCP improvements – Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit.

Text Books:
1. Theodore S. Rappaport, Wireless communications: principles and practice, PHI / Pearson education.
2. J. Schiller, Mobile communications, Addison-Wesley.
3. William C. Y. Lee, Mobile cellular telecommunication – analog and digital systems, McGraw Hill, 2nd

ed.
4. Wang, Wireless communication System, Pearson Education
5. Talukdar, Mobile computing, TMH
6. J.W.Mark, W. Zhuang, Wireless Communication and Networking, PHI

TITLE OF COURSE: SOFT NANO TECHNOLOGY
COURSE CODE: MVLSI205B
L-T-P: 3-1-0
CREDITS: 4

Course Outcomes:
In this course we will learn how to create nano patterns on Soft Surfaces, particularly on Polymer films by various techniques. We will start out discussion with certain general concepts related to nano patterning, understand various issues related to Surface Tension and look into some applications of Nano Patterned surfaces (Module 1). Subsequently we will talk about Photolithography (Module 2) and various Soft Lithography techniques (Module 3) that allow crating nano pattern. Finally, we will learn the basic working principle and functioning of a very important instrument that is widely utilized in Nanotechnology research: the Atomic Force Microscope (Module 4).

Course Contents:

Module-1:
Introduction to Patterning of Thin Films. Application of Nano-Patterned Films and Surfaces. Basic Concepts of Wetting: Cassie and Wenzel Regimes. Basic Concepts of Surface Tension. Different Nano Fabrication Regimes, including self-assembly, Micelle formation, Introduction to Photo Lithography

Module-2:
Discussion on Photo Lithography: Photo Resists, Spin Coating, Exposure Development, Nano Imprint Lithography

Module-3:
Soft Lithography: Introduction to Soft Lithography Techniques

Module-4:
Basic Concepts of Atomic Force Microscopy. Different Imaging Modes of Atomic Force Microscopy

Text Books

1. Alternative Lithography", C. M. Sotomayor Torres (Ed.), Kluwer Academic Press, 2003.

Reference books

1. Creating Micro and Nano Patterns on Polymeric Materials", A del Campo and E. Arzt (Ed), Wiley, 2011.
2. "Micro Fluidics and Micro Scale Transport Process", Suman Chakraborty (Ed), CRC Press, 2013

TITLE OF COURSE: EMBEDDED SYSTEM LAB-II
COURSE CODE: MVLSI283
L-T-P: 0-0-3
CREDITS: 2
Course Outcomes (CO):
Upon successful completion of this course:
CO1: Students can interface peripheral devices with embedded processors.
CO2: Students can choose appropriate microcontroller for the design specification with reference to a real time problem.

CO3: Students can troubleshoot embedded based hardware devices

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓		✓		✓	✓				✓
CO2				✓			✓	✓				✓
CO3		✓	✓				✓	✓				✓

Course Contents:
Exercises that must be done in this course are listed below:
Exercise No.1: Write an assembly language program to add, subtract, multiply, divide 16 bit data by Atmel microcontroller.
Exercise No. 2: Write an assembly language program to generate 10 KHz frequency using 8051.
Exercise No. 3: To study the implementation & interfacing of LCD using 8051 microcontroller
Exercise No. 4: To study implementation & interfacing of LED
Exercise No. 5: To study implementation & interfacing of seven segment display
Exercise No. 6: To study implementation & interfacing stepper motor with 8051 microcontroller
Exercise No. 7: To study implementation & interfacing of relay with 8051 microcontroller
Exercise No. 8: To study implementation & interfacing of keypad with 8051 microcontroller
Exercise No. 9: Study of implementation of DC Motor control using PWM method. Exercise No. 10: Study and observation of Position control of Servo Motor
Text Book:
1. Muhammad Ali Mazidi, J.G. Mazidi, R.D.McKinlay,The 8051 Microcontroller and Embedded Systems, Pearson Prentice Hall.